TC 0076-06

FINAL REPORT
REMEDIAL INVESTIGATION

WAREHOUSE AREA WASTE PILE

CAMP NAVAJO
BELLEMONT, ARIZONA

July 1999

Prepared for:

US Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

and

Arizona Army National Guard
Camp Navajo
Bellemont, Arizona 86015-5000

Prepared by:

Tetra Tech, Inc.
180 Howard Street, Suite 250
San Francisco, California 94105-1617

REMEDIAL INVESTIGATION
AT
CAMP NAVAJO

WAREHOUSE AREA WASTE PILE

FINAL REPORT

Contract DACA05-93-D-0019

PREPARED BY:

TETRA TECH, INC.

Approved by:	______________________________ Bradley S. Hall, RG Tetra Tech, Inc. Project Manager	____________ Date
Approved by:	______________________________ Maynardo Aala US Army Corps of Engineers, Sacramento District Technical Manager	____________ Date
Approved by:	______________________________ Guy Romine National Guard Bureau, Installation Restoration Program Manager	____________ Date

TABLE OF CONTENTS

Section | Page

LIST OF FIGURES

Figure | Page

TABLES

LIST OF APPENDICES

LIST OF ACRONYMS

Acronym	Full Phrase
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ANL	Argonne National Laboratory
AZNG	Arizona National Guard
bgs	below ground surface
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
GSA	General Services Administration
HBGL	health based guidance levels
LCS	laboratory control sample
LDC	Laboratory Data Consultants
MK	Morrison Knudsen Corp.
MS	matrix spike
MSD	matrix spike duplicate
OC	organochlorine
PCB	polychlorinated biphenyl
QC	quality control
RI	remedial investigation
RPD	relative percent difference
SS	surface soil
SSL	soil screening level
TEPH	total extractable petroleum hydrocarbons
TOC	total organic carbon
TRPH	total recoverable petroleum hydrocarbons
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

SECTION 1
INTRODUCTION

1.1. PURPOSE OF REPORT

This report summarizes the results of the remedial investigation conducted at the warehouse area waste pile (NAAD 47, NADA 26, AREE 47) (WAWP, site) at Camp Navajo (formerly Navajo Depot Activity), in Bellemont, Arizona (Figure 1-1). Tetra Tech was retained by the United States Army Corps of Engineers (USACE) to conduct the work described in this report.

1.2. SITE BACKGROUND

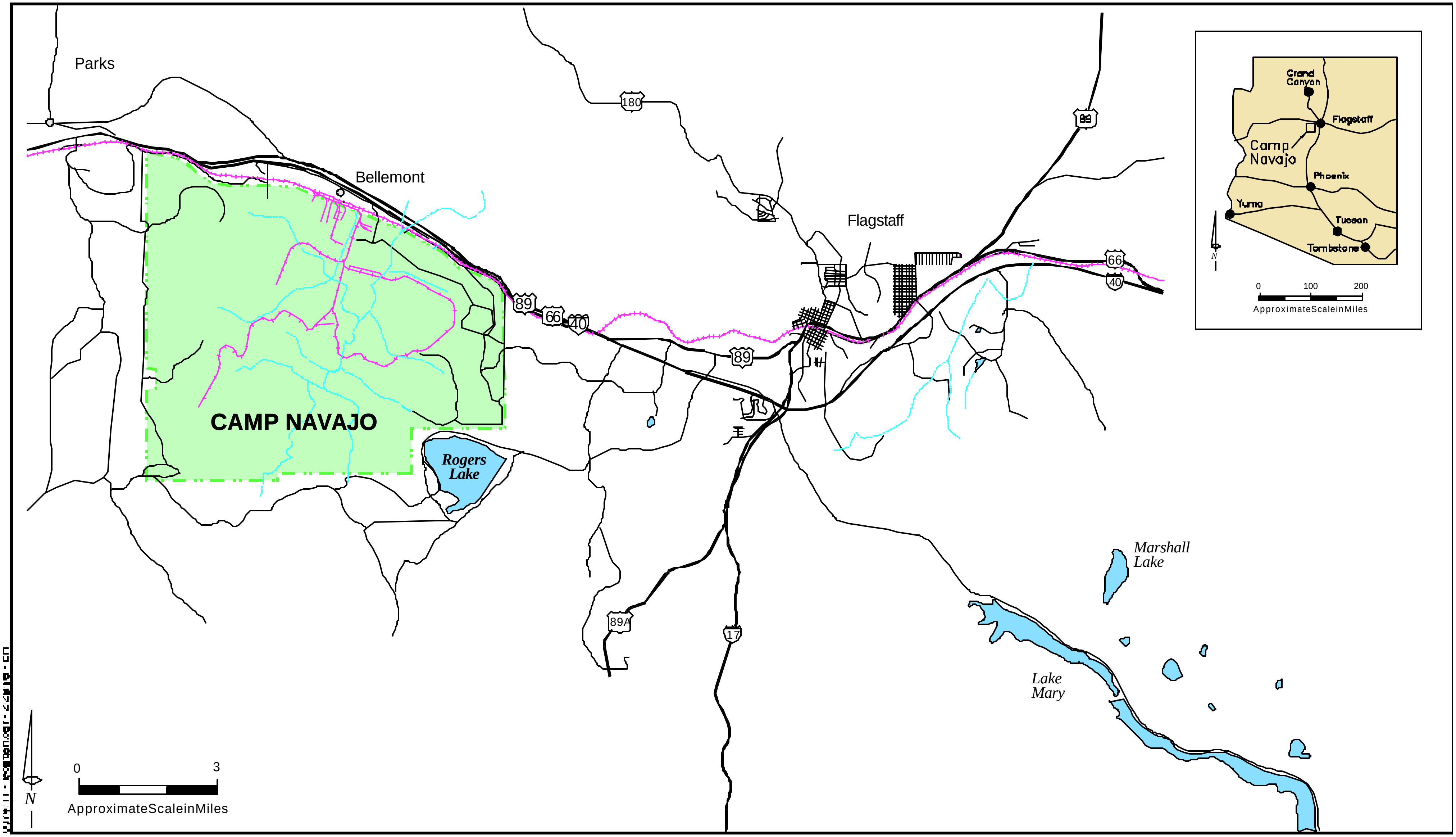
1.2.1. Site Description

The warehouse area waste pile (Figure 1-2) east of the GSA warehouses (Figure 1-3) was situated partially on the concrete pad of former Building 233 and partially on the adjacent ground surface (USAEHA 1987). The 70 by 160-foot pile was removed to an off-site landfill at the time of the Argonne National Laboratory (ANL) site visit in 1990.

The warehouse area waste pile contained concrete, soil, metal parts, fencing, an old boiler, metal lockers, metal storage cabinets, steel cable, wood, empty and partially full 55-gallon drums (four plastic and nine steel), two 20-gallon drums containing grease, and numerous 5-, 10-, and 20-gallon buckets and drums that were mostly empty (USAEHA 1987). Tetra Tech noted in a 1994 inspection that the pile had been removed and disposed of.

1.2.2. Previous Investigations

Tetra Tech found no information regarding previous investigations of the warehouse area waste pile.



CampNavajoisinnorthcentralArizona
about12milesw estofthecityofFlagstaff.

LEGEND:

Highways

Roads

Railroad

Rivers/Streams

Camp Navajo Location Map

Camp Navajo
Bellemont,Arizona

Figure 1-1

Tetra Tech, Inc.

Legend:

Fence
Grass
Railroad

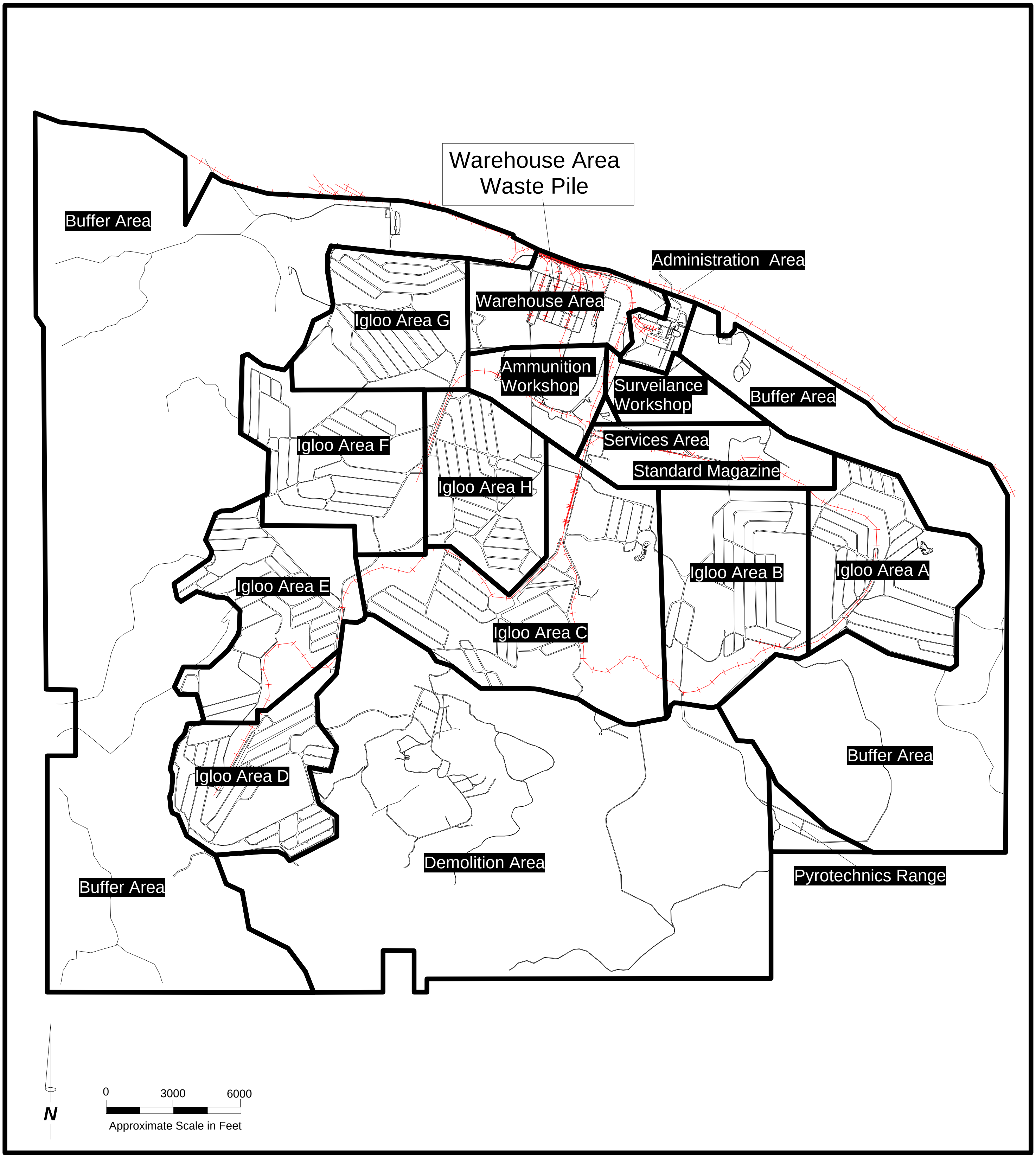
Warehouse Area Waste Pile

Site Plan

Camp Navajo, Bellemont, Arizona

Tetra Tech, Inc.

Figure 1-2



Warehouse Area Waste Pile

Site Map

Camp Navajo, Bellemont, Arizona

Tetra Tech, Inc.

Figure 1-3

1.3. STATEMENT OF THE PROBLEM

Previous operations at this site likely resulted in the release of wastes containing metals, petroleum hydrocarbons, pesticides, polychlorinated biphenyls (PCBs), and solvents. Of specific concern is the contamination in the surface and subsurface soils.

1.4. REPORT ORGANIZATION

This report follows United States Environmental Protection Agency (USEPA) guidance for remedial investigation (RI) reports in the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA 1988). Section 2 describes the field investigations conducted as part of the RI. Sections 3 and 4 present the physical and chemical results, respectively. Section 5 presents a discussion of the fate and transport characteristics of the contaminants. Section 6 presents risk screening for the identified contaminants. All results are summarized with conclusions in Section 7.

SECTION 2
SAMPLING PROGRAM

2.1. SAMPLING OBJECTIVES

The objectives of the investigation of the warehouse area waste pile are to identify potential surface contamination associated with residue of the former waste pile and to evaluate the potential for subsurface contamination.

2.2. SAMPLING APPROACH

Photo documentation is provided in Appendix A. Field notes are presented in Appendix B. Field investigations were conducted in accordance with the procedures outlined in the field sampling plan provided in Appendix C. Surveyor results can be found in Appendix D.

Task 1: Surface Soil Sampling

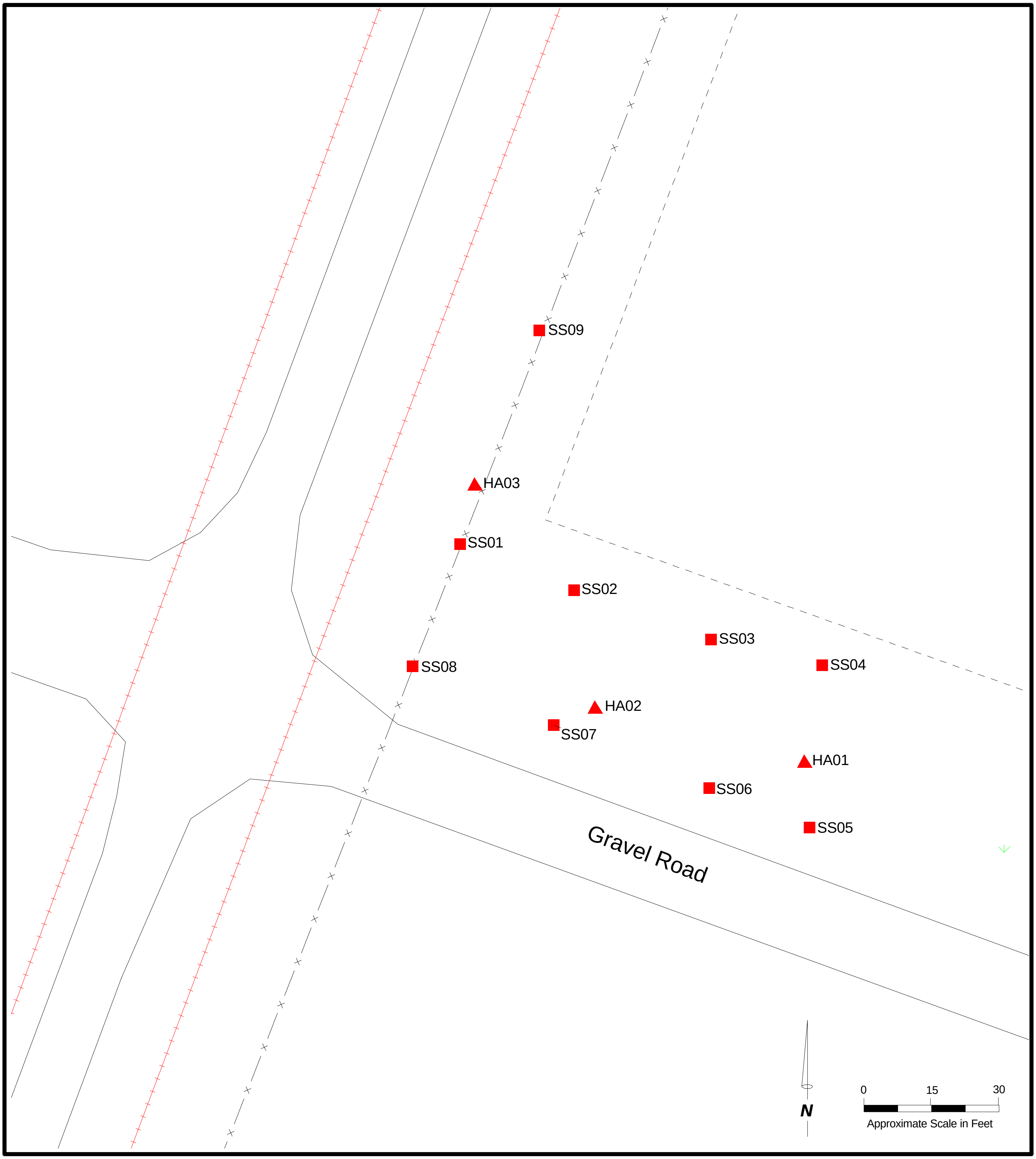
Surface sampling was performed on a 30-foot grid across the site. Nine surface soil samples were taken at the locations shown in Figure 2-1. Samples were collected by driving a 2-inch by 12-inch California modified split spoon sampler, as described in Appendix C. As shown in Table 2-1, the laboratory analytical program for surface soil samples included metals, petroleum hydrocarbons, organochlorine (OC) pesticides, PCBs, percent water, and pH. One sample also was analyzed for total organic carbon (TOC), redox potential, bulk density, and grain size.

Task 2: Hand Auger Sampling

Due to auger refusal on basalt boulders at 1.5 feet, no hand auger samples were collected.

Task 3: Surveying

After the investigation was completed, Aztech Surveying, an Arizona-licensed land surveyor, surveyed the horizontal location of the samples. Horizontal coordinates for each location were surveyed relative to a permanent control point



Legend:

Hand Auger Location
Fence
Railroad
Surface Soil Sample/Sediment Sample

Tetra Tech, Inc.

Warehouse Area Waste Pile

Site Plan

Camp Navajo, Bellemont, Arizona

Figure 2-1

Table 2-1
Warehouse Area Waste Pile Sample Analysis

Sample ID	Sample Date	Depth (feet)	Media	Percent Water ASTM D2216	pH SW9045B	Total Organic Carbon WBLACK	Redox Potential ASTM D1498	Dry Density ASTM D2937	Particle-Size Distribution ASTM D422	Metals SW6010A	Mercury SW7471A	Petroelum Hydrocarbons BLS-191	Petroelum Hydrocarbons BLS-418 1 AZ	OC Pesticides and PCBs SW8081
WAWP-SS01S-01	09/27/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS02S-01	09/26/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS03S-01	09/26/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS04S-01	09/27/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS05S-01	09/26/1995	1	Soil	X	X	X	X	X	X	X	X	X	X	X
WAWP-SS06S-01	09/26/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS07S-01	09/27/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS08S-01	09/27/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS09S-01	09/27/1995	1	Soil	X	X					X	X	X	X	X
WAWP-SS10S-01*	09/26/1995	1	Soil	X	X					X	X	X	X	X

Notes:

*	Blind duplicate sample (See section 4.2)
ASTM	American Society for Testing and Materials

established on-site. Horizontal control is accurate to ± 0.1 feet. Sample locations in Figure 2-1 are based on survey results. A table of surveyed sample locations is included in Appendix D.

2.3. SAMPLE ANALYSIS

Ten soil samples were collected and analyzed during this investigation. Soil sample analyses conducted as part of this investigation included metals, petroleum hydrocarbons, TOC, OC pesticides and PCBs, redox potential, percent moisture, and pH by Quanterra Laboratories in California. One soil sample also was analyzed for bulk density and particle-size distribution by Earth Tech Laboratories in California. Table 2-1 summarizes the samples collected and the types of analyses conducted on each soil sample.

SECTION 3
PHYSICAL CHARACTERISTICS

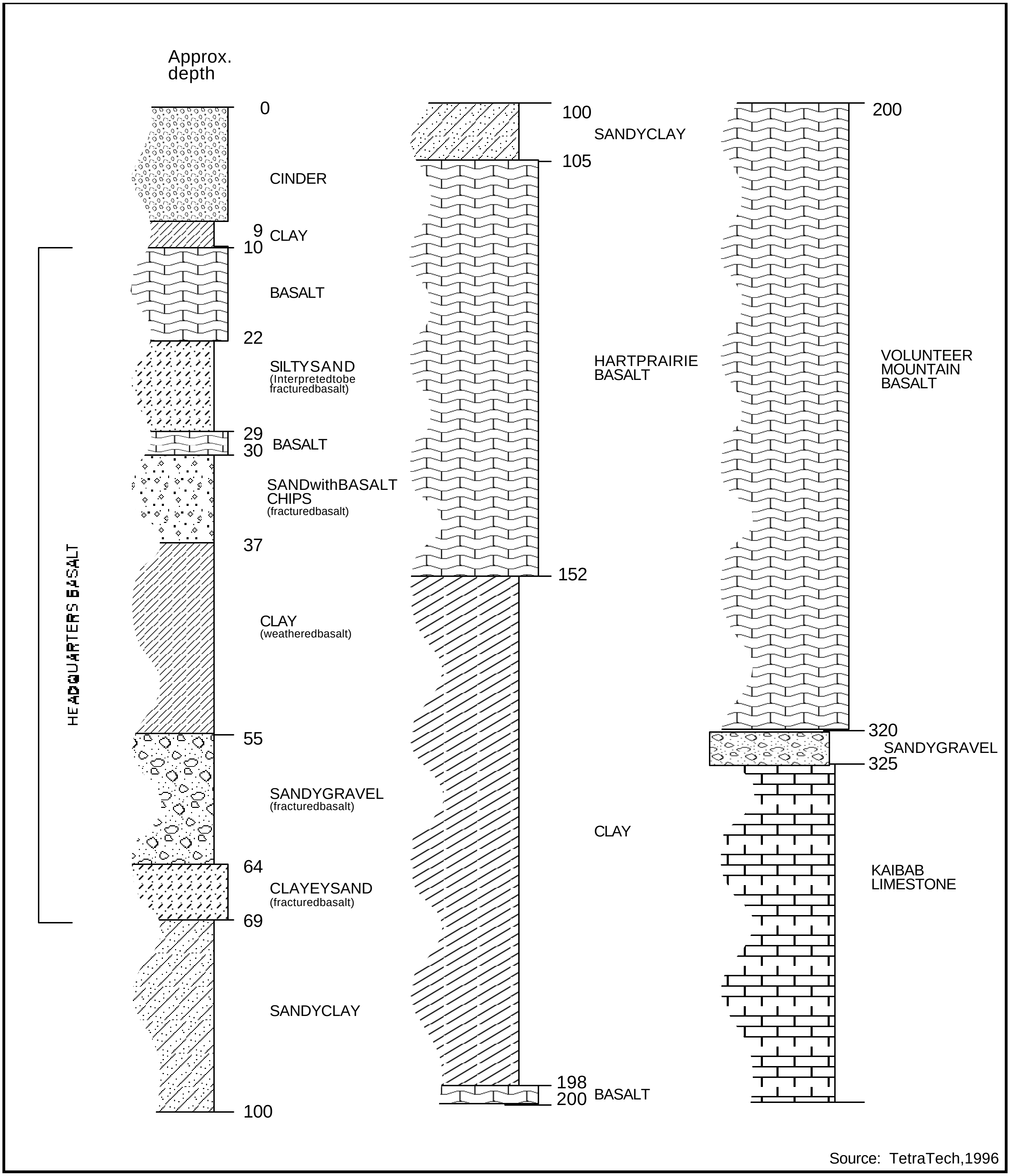
3.1. SURFACE FEATURES

Surface features at the site consist of a 141,000 square foot concrete pad remaining from the demolition of Building 233. The building is located in the central portion of the warehouse area (Figure 1-2). Unpaved ground surface surrounding the building is covered with gravel or grass.

The topography in the area of the WAWP is generally of low relief, and slopes to the south. There is a northeast-southwest trending escarpment approximately 3,100 feet east of the site (Bellemont Fault). This feature has an increase in ground surface elevation of about 80 feet. Ground surface generally consists of gravel with less than 50 percent of sand.

3.2. GEOLOGY

The following description of the geologic units deeper than 20 feet is compiled from surface geologic mapping, from soil borings in other portions of the Warehouse Area, and from geophysical surveys (Figures 3-1 and 3-2) (Tetra Tech 1999a). A monitoring well drilled in 1996 (Tetra Tech 1999b) approximately 2,000 feet east of the site encountered a thin veneer (<10 feet) of clayey soil overlying a thickness of basalt. This basalt is interpreted to be the Headquarters Basalt which underlies the entire Warehouse Area as well as the adjacent Administration Area. The flow is estimated to be about 60 feet thick and overlies a thickness (<35 feet) of Camp Navajo Clay. The Camp Navajo Clay was deposited directly on top of a second basalt flow. This second basalt flow is interpreted to be the Hart Pairie basalt and is 45 feet thick. Below the second basalt is a second clay (45 feet thick) and a third basalt. The third basalt is interpreted to be the Volunteer Mountain basalt and is 120 feet thick. Below the third basalt is a thin zone of gravel and weathered Kaibab Formation (<20 feet) and the underlying Kaibab Formation.

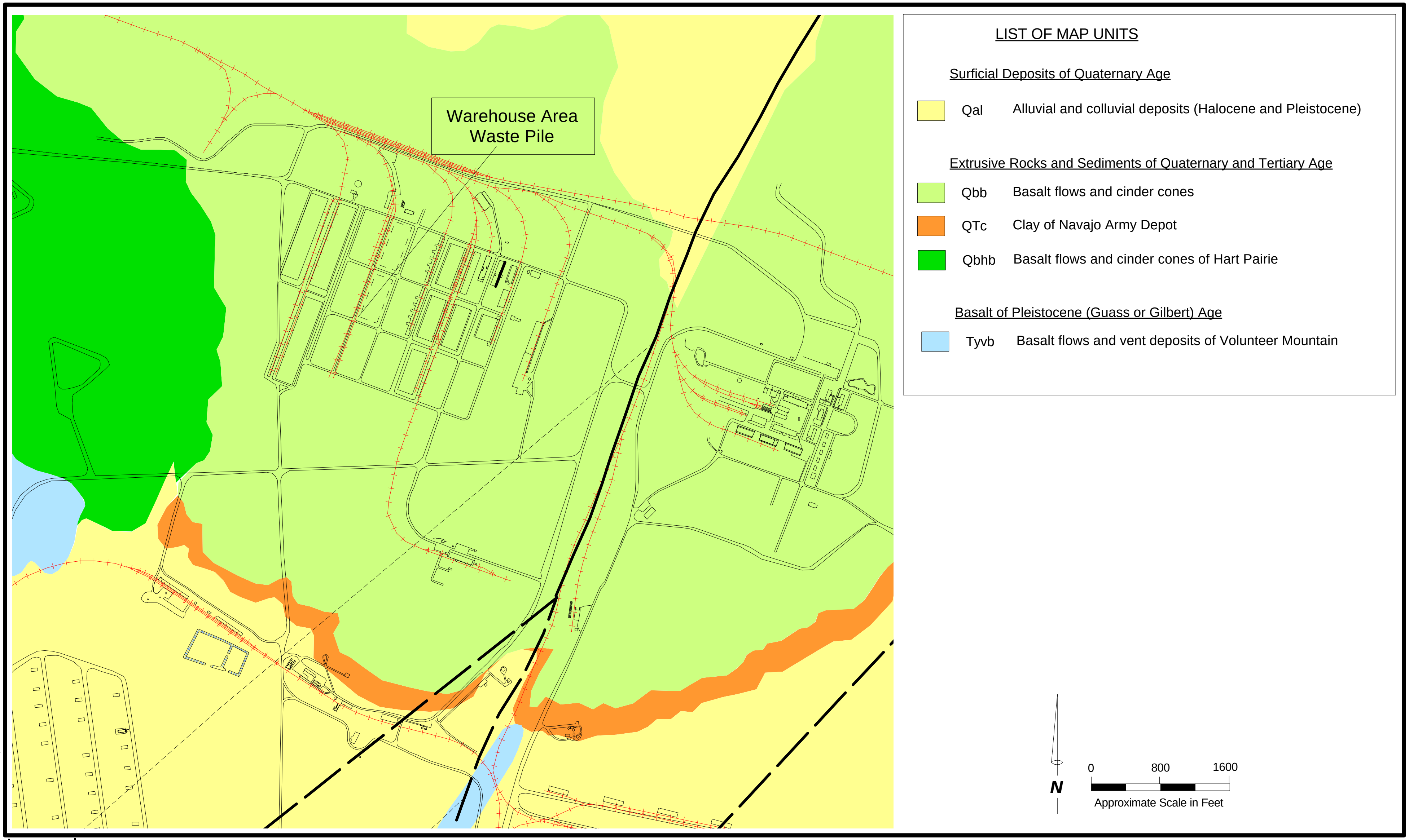


Warehouse Area Waste Pile Stratigraphy

CampNavajo
Bellemont, Arizona

Tetra Tech, Inc.

Figure 3-1



Workspace: NAVAJO.WOR

Legend:

- Faults
- Lineaments/ Fracture Zones
- Railroad

Warehouse Area Geology

Camp Navajo, Bellemont, Arizona

Tetra Tech, Inc.

Figure 3-2

3.3. SOILS

The soils beneath the site have been classified by the Navajo Army Depot Soil Survey, Coconino County, Arizona, as Soil Unit 10 (USDA 1970). Soil Unit 10 soils are moderately deep, gravelly clay soils with a loam surface and usually have zero to five percent slopes. The surface soil is generally a brown granular loam, having a pH of 7.0 and a thickness of three to five inches. The subsoil is generally dark reddish gray gravelly clay with a blocky structure, having a pH of 7.8 and a thickness of 20 to 30 inches. This type of soil comprises approximately five percent of Navajo Army Depot soils, which accounts for approximately 1,400 acres of land on the base.

Physical testing of the soil samples collected during this investigation showed moisture at five percent. Dry densities of the soils range was 75.6 pounds per cubic foot (pcf). Grain size distributions was 19 percent gravel, 58 percent sand, 23 percent fines. All physical analysis results are included in Appendix F.

3.4. HYDROGEOLOGY

Four water bearing zones have been identified within the upper 2,000 feet beneath the warehouse area. The uppermost zone, which feeds the springs from which the base receives its water supply, exists in fractures in the bottom of the uppermost basalt flow. The bottom of this zone is marked by a 30-foot thick clay aquitard at a depth of 70 feet bgs. A second water bearing zone exists in fractures at the base of the second basalt flow and is bounded on the bottom by a second clay aquitard at a depth of 150 feet bgs. A third water bearing zone exists in a 50 foot thick deposit of stream gravels and volcanic cinder that directly overlies the Kaibab Formation at a depth of 350 feet bgs. The fourth water bearing zone is the regional aquifer in the Coconino and Supai Formations at a depth of about 1,300 feet bgs.

Ground water recharge to the various water bearing zones occurs along fractures in the basalt flows and through fractures in the underlying Kaibab limestone. The presence and lateral continuity of the aquitards suggests that downward migration does not occur homogeneously throughout the area but is limited to areas of fracturing and faulting. In addition, the existence of the water bearing zones within fractures in the basalt suggests that contaminant migration would not be predictable using standard hydrogeologic techniques. Thus, remediation of contaminants in the ground water within the basalt zones would be problematic.

No drilling was done as part of the investigation of the WAWP. Laterally discontinuous perched ground water conditions may exist throughout the alluvium. Drilling northeast, southeast, and east of the site also identified perched ground water within fractures in the basalt overlying the Camp Navajo Clay. Deeper ground water is likely to be present at an approximate depth of 1,300 feet bgs. This is based on the depth to the regional aquifer as measured in the deep water supply well 8,000 feet south of the site.

SECTION 4
NATURE AND EXTENT OF CONTAMINATION

The following section summarizes the nature and extent of contamination identified at the WAWP. All analytical results are tabulated by analysis method in Appendix E. Soil physical characteristics are in Appendix F. Appendix G includes copies of all laboratory reports for this site.

4.1. SURFACE SOILS

Concentrations of various metals occur naturally in soils. With the exception of lead, no metals were identified at concentrations above background in any of the surface soil samples collected at this site (Table 4-1). Concentrations of lead were detected above background (30 mg/kg) in three surface soil samples (up to 90.4 mg/kg) (Figure 4-1). All detected metals concentrations were detected at concentrations less than the Arizona Department of Environmental Quality (ADEQ) nonresidential Health Based Guidance Levels (HBGLs).

Background concentrations were established by statistical analysis of all samples collected at Camp Navajo. Outliers were identified during the analysis and were eliminated from the statistical test prior to determination of the background concentrations (Tetra Tech 1997).

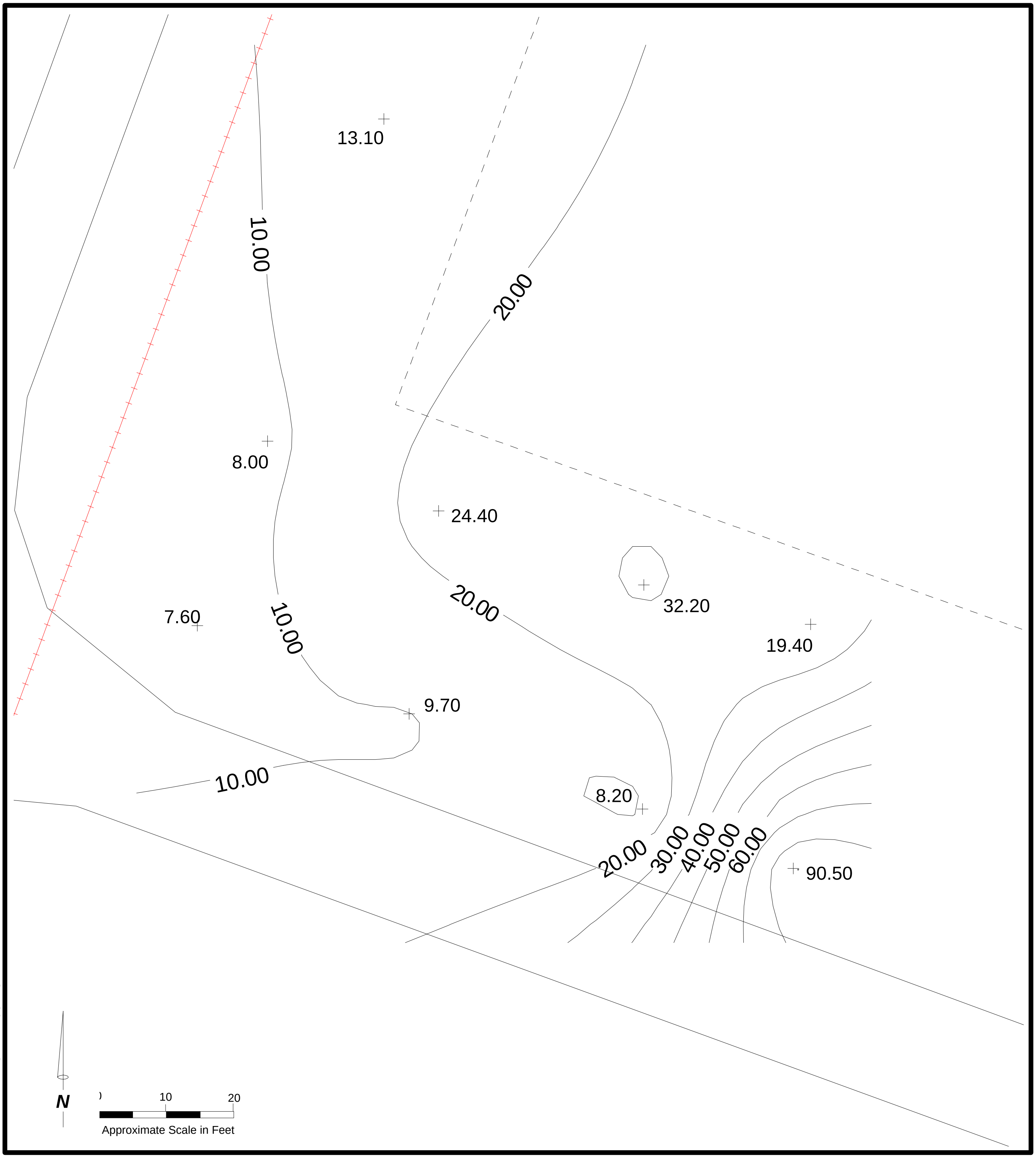
Concentrations of petroleum hydrocarbons were identified in the surface soil samples collected at this site (Table 4-2). Concentrations of TRPH were detected in all ten surface soil samples (up to 350 mg/kg). None of the detected concentrations exceeded Arizona Department of Environmental Quality (ADEQ) residential Health Based Guidance Level (HBGL) and thus is not considered to be a contaminant of concern. The other detected petroleum hydrocarbon (Diesel Fuel #2) does not a have set HBGL but was detected at concentrations up to 560 mg/kg in eight samples and is evaluated in Section 6.

Table 4-1
Warehouse Area Waste Pile Metals Results
(Detections Only)

Sample ID	Sample Date	Depth	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Lead, Total	Potassium, Total	Selenium, Total	Silver, Total
	CRQL		0.5	2	0.2	0.2	0.5	0.5	500	0.5	0.5
	Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	0.91	153	0.49	< 0.05	15.6	8	1040	< 0.3	0.16 J
WAWP-SS02S-01	09/26/1995	1	2.2	99.8	0.7	0.2 U	11.4	24.4	1190	< 0.6	< 0.2
WAWP-SS03S-01	09/26/1995	1	2.9	88.4	0.5	< 0.05	9.6	32.2	1140	0.41 J	< 0.1
WAWP-SS04S-01	09/27/1995	1	1.1	36.1	0.38	< 0.05	5.7	19.4	606	< 0.3	< 0.1
WAWP-SS05S-01	09/26/1995	1	0.56 J	94.8	0.41	1 J	14.4	90.5 J	1060	< 0.3	< 0.1
WAWP-SS06S-01	09/26/1995	1	0.7 J	365	1	0.31 J	19	8.2	1350	< 0.6	0.25 J
WAWP-SS07S-01	09/27/1995	1	0.88	144	0.73	< 0.05	12.1	9.7	885	< 0.3	0.12 J
WAWP-SS08S-01	09/27/1995	1	< 0.3	78.5	0.36	< 0.05	16	7.6	771	0.33 J	< 0.1
WAWP-SS09S-01	09/27/1995	1	1.6	216	0.77	< 0.05	18.6	13.1	1570	< 0.3	0.15 J
WAWP-SS10S-01	09/26/1995	1	1.1 J	116	0.52	0.3 UJ	14.9	40.1 J	1210	< 0.3	0.13 J

	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Lead, Total	Potassium, Total	Selenium, Total	Silver, Total
Analyses	10	10	10	10	10	10	10	10	10
Detections	9	10	10	4	10	10	10	2	5
Maximum Concentration	2.9	365	1	1	19	90.5	1570	0.41	0.25
Arizona HBGL - Nonresidential	3.82	28700	1.34	244	5950	1400		2030	2030
Arizona HBGL - Nonresidential Hits	0	0	0	0	0	0		0	0
Maximum Background Concentration	44	1610	5	1.5	90	30	0	0.8	2.6
Background Hits	0	0	0	0	0	3	0	0	0

Notes:
CRQL Contract required quantitation limits
< Less than the indicated detection limit
Data qualifiers are defined in Appendix E.



Legend:

Fence
Railroad
11.70 All concentrations in parts per million (ppm)

Warehouse Area Waste Pile

Lead Concentrations in Surface Soils

Camp Navajo, Bellemont, Arizona

Tetra Tech, Inc.

Figure 4-1

Table 4-2
Warehouse Area Waste Pile Petroleum Hydrocarbon Results
(Detections Only)

Sample ID	Sample Date	Depth	TPH, Recoverable	Diesel Fuel 2
	CRQL		10	10
	Units		mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	30 J-	49 J+
WAWP-SS02S-01	09/26/1995	1	45 J-	290 J+
WAWP-SS03S-01	09/26/1995	1	280 J-	780 J
WAWP-SS04S-01	09/27/1995	1	290 J-	220 J
WAWP-SS05S-01	09/26/1995	1	350 J-	12 J
WAWP-SS06S-01	09/26/1995	1	68 J-	< 0
WAWP-SS07S-01	09/27/1995	1	300 J-	360 J+
WAWP-SS08S-01	09/27/1995	1	30 J-	< 0
WAWP-SS09S-01	09/27/1995	1	120 J-	560 J
WAWP-SS10S-01	09/26/1995	1	200 J-	< 0

Analyses	10	10
Detections	10	7
Maximum Concentration	350	780
Arizona HBGL - Nonresidential		
Arizona HBGL - Nonresidential Hits		
Arizona HBGL - Residential	7000	
Arizona HBGL - Residential Hits	0	

Notes:
CRQL Contract required quantitation limits
< Less than the indicated detection limit
Data qualifiers are defined in Appendix E.

One PCB compound and two pesticide compounds were identified in surface soil samples collected from the site (Table 4-3). Two pesticides (4,4-DDD and 4,4-DDT) were identified at this site. One PCB (Aroclor 1260) was identified at this site. The detected concentrations were below the ADEQ nonresidential HBGLs and thus are not considered contaminants of concern.

4.2. QA/QC

All samples were sent to Quanterra Incorporated (Quanterra) of Santa Ana, California for inorganic and organic parameter analyses. Temperature blanks for all coolers forwarded to the laboratory were within an acceptable range, and all coolers arrived with custody seals intact. Applicable holding times were met for all analyses. One field duplicate pair (WAWP-SS10S-01 blind duplicate of WAWP-SS05S-01), a set of surface soil (SS) samples, was collected at the site during the investigation, as shown below. Validation of the data was conducted by Laboratory Data Consultants, Inc. (LDC) of Carlsbad, California.

General validation findings applicable to both inorganic and organic data resulted in the qualification of select compound concentrations located above the method detection limit but below the respective sample quantitation limit prior to dilution and percent moisture corrections. These reported values are considered to be qualitatively acceptable but quantitatively estimated due to uncertainties in analytical precision near the limit of detection. According to USEPA guidelines, however, these low concentration data are considered suitable for risk evaluation applications with appropriate recognition of the noted quantitative uncertainties.

Polychlorinated Biphenyls and Organochlorine Pesticides by USEPA Method 8081

Evaluation of field duplicate results for the PCB and OC pesticide analyses indicated excellent qualitative and quantitative agreement between reported results. All relative percent differences (RPDs) were within quality control (QC) criteria, and hence, all PCB and OC pesticide field duplicate results are considered acceptable.

Results of the validation by LDC indicated potential quantitative uncertainties in nondetect 4,4'-DDE, endosulfan sulfate, endrin aldehyde, and endrin ketone results for all surface soil samples, based on calibration performance exceeding data assessment criteria. Analytical data for the associated samples indicated in Appendix D were flagged as quantitatively estimated. However, all associated matrix spike/matrix spike duplicate (MS/MSD) and laboratory control sample (LCS) recoveries for affected samples were within QC acceptance criteria. Moreover, the magnitude of any potential quantitative biases likely would be insignificant relative to the respective health-based limits established for these compounds. Hence, qualified nondetect OC pesticide results are considered quantitatively estimated but usable for risk evaluation, according to USEPA guidelines.

Table 4-3
Warehouse Area Waste Pile Pesticide and PCB Results

(Detections Only)

Sample ID	Sample Date	Depth	4,4-DDD	4,4-DDT	Aroclor 1260
	CRQL		0.0033	0.0033	0.033
	Units		mg/kg	mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	0.015 J	0.019	< 0.012
WAWP-SS05S-01	09/26/1995	1	< 0.0035	< 0.0031	0.33
WAWP-SS10S-01	09/26/1995	1	< 0.0035	< 0.0031	0.29

Analyses	10	10	10
Detections	1	1	2
Maximum Concentration	0.015	0.019	0.33
Arizona HBGL - Nonresidential	23.9	17	0.76
Arizona HBGL - Nonresidential Hits	0	0	0

Notes:
CRQL Contract required quantitation limits
< Less than the indicated detection limit
Data qualifiers are defined in Appendix E.

All other PCB and OC pesticide data for submitted samples were determined to be valid without qualification and were considered usable for all purposes.

Total Extractable Petroleum Hydrocarbons by ADHS Method BLS-191

Evaluation of field duplicate results for the total extractable petroleum hydrocarbon (TEPH) analyses indicated a general quantitative agreement between reported results. The RPD for the single field duplicate pair was considered incalculable since one surface soil sample involved in the computation contained a trace hydrocarbon concentration, while the other sample had a nondetect TEPH result below the respective quantitation limit. This incident of imprecision may be attributable to the high clay content and typical heterogeneity of soils in the Camp Navajo area. Although USEPA guidelines for organic data assessment do not require data qualification on the basis of field duplicate precision alone, TEPH results for the indicated samples were flagged as quantitatively estimated in Appendix D. However, no restrictions on data usability for risk evaluation applications are expected.

Validation findings suggested the potential for high biases in TEPH results for several surface soil samples based on surrogate spike recoveries above the upper QC acceptance criteria for accuracy. As indicated in Appendix D, TEPH results for samples WAWP-SS01S-01, WAWP-SS02S-01, and WAWP-SS05S-01 were flagged as quantitatively estimated with a probable high bias.

Reanalyses confirmed initial results that LCS recoveries were all within acceptable limits. Deviations were attributed by the laboratory to sample matrix interferences. However, the potential high biases expressed in TEPH surrogate spike performances would not be expected to impact sample concentrations quantitated significantly below health-based levels of concern. According to USEPA guidelines, data were qualified as estimated and were considered usable for risk evaluation applications.

Validation of TEPH results also indicated a general qualitative uncertainty associated with identifying of the reported hydrocarbon species. Quantifyingof reported TEPH results was accomplished using diesel fuel reference standards since chromatographic profiles observed in sample analyses were not consistent with the patterns obtained from known hydrocarbon reference standards. Due to both the default application of diesel fuel reference factors and the high degree of uncertainty in the petroleum hydrocarbon identifications, the resulting TEPH values are considered quantitatively estimated and are reported as unknown hydrocarbons.

All other TEPH data for submitted samples were determined to be valid without qualification and were considered usable for all purposes.

Total Recoverable Petroleum Hydrocarbons by ADHS Method BLS-418.1AZ

Evaluation of field duplicate results for the total recoverable petroleum hydrocarbon (TRPH) analyses also indicated a general quantitative agreement between reported results. Although the RPD reported for the single field duplicate pair was slightly outside the QC acceptance criteria for precision, this incident of imprecision may be attributable both to elevated TRPH concentrations in the field duplicate pair and to the high clay content and typical heterogeneity of soils in the Camp Navajo area. Although USEPA guidelines for organic data assessment do not require qualification of data on the basis of field duplicate precision alone, TRPH results for the indicated samples were flagged as quantitatively estimated in Appendix D. However, no restrictions on data usability for risk evaluation applications are expected.

Validation findings indicated potential low biases in TRPH results for all surface soil samples, based on matrix spike/matrix spike duplicate (MS/MSD) recoveries significantly below the lower QC acceptance criteria for accuracy. Reanalysis confirmed the initial results, and TRPH data for associated field samples indicated in Appendix D were flagged as quantitatively estimated with a probable low bias. Moreover, all LCS recoveries were acceptable and the MS/MSD deviations were attributed to sample matrix interferences by the laboratory. According to USEPA guidelines, these data (flagged with a J) are considered usable for risk evaluation applications with an appropriate recognition of the noted quantitative biases.

All other TRPH data for submitted samples were determined to be valid without qualification and were considered usable for all purposes.

Metals by USEPA Methods 6010A and 7471A

Evaluation of field duplicate results for the metals analyses indicated satisfactory qualitative and quantitative agreement between reported results for the ten target elements. All RPDs were within QC acceptance criteria with the exception of arsenic, cadmium, and lead in field duplicates WAWP-SS05S-01and WAWP-SS10S-01.

These incidents of imprecision may be attributable to the high clay content and typical heterogeneity of soils in the Camp Navajo area. In addition, all noted situations involved element concentrations below applicable health-based action levels. Although USEPA guidelines for inorganic data assessment do not require data qualified on the basis of field duplicate precision alone, associated results for the indicated samples were flagged as quantitatively estimated in Appendix D. However, no restrictions on data usability for risk evaluation applications are expected.

Validation findings noted trace contamination in several QC system calibration blanks as potentially impacting low-level cadmium data for the site. Although concentrations observed in the QC blanks were less than one-half of the respective sample quantitation limits, cadmium results for field samples WAWP-SS02S-01 and WAWP-SS10S-01 were qualified as nondetected in Appendix D and were considered to be usable for risk evaluation purposes at an adjusted reporting limit. All other metals data for submitted samples were determined to be valid without qualification and were considered useable for all purposes.

TOC analyses were not performed for the designated field duplicate pair; therefore, no TOC field duplicate data from the site were available for review. All other TOC data for submitted samples were determined to be valid without qualification and were considered useable for all purposes.

4.3. Interim Removal Actions

Under contract with the USACE, Morrison Knudsen Corporation (MK) removed the PCB contamination south of the building (MK 1996) (Appendix H).

On October 4, 1996, an area was excavated at the site, south of Building 233, based on one Tetra Tech sample (SS05), to a depth of about 12 inches. Approximately five tons of contaminated soil was placed in plastic lined waste bins for disposal. MK backfilled the excavations with imported AB roadbase and compacted the fill as directed by the AZNG.

Two confirmation samples were taken from the excavation. No concentrations of PCBs were detected above ADEQs nonresidential HBGLs (Table 4-4).

Table 4-4
Warehouse Area Waste Pile PCB Results

Sample ID	Sample Date	Depth	PCBs
		CRQL	0.033
		Units	mg/kg
34	10/04/1996		< 0.020
35	10/04/1996		< 0.020

Analyses	2
Detections	0
Maximum Concentration	0
Arizona HBGL - Nonresidential	0.76
Arizona HBGL - Nonresidential Hits	0

Notes:
CRQL Contract required quantitation limits

SECTION 5
CONTAMINANT FATE AND TRANSPORT

Section 4 discussed the potential contaminants of concern for the warehouse area waste pile laboratory site soils and ground water. In the surface soils lead was found in three samples at levels above the maximum background level set for the installation. The industrial HBGL was not exceeded for any chemical analyte. This section provides a summary of the potential routes of migration, ability to persist in the environment, and relative migration potential for these contaminants of concern.

5.1. POTENTIAL ROUTES OF MIGRATION

The same potential routes of migration exist for organic and inorganic compounds in soils. The contaminants can become dissolved in infiltrating precipitation and transported vertically downward. This process can be quite rapid where near-vertical open channels, such as solution planes or fractures, exist. Overland routes of migration include transport by wind as particulates, or excavation and transport by human beings or animals.

5.2. CONTAMINANT PERSISTENCE

As an element, lead cannot be further degraded. In subsurface environments elemental metals often form silicate, carbonate and sulfate precipitates.

5.3. CONTAMINANT MIGRATION

The rate of migration of metals in saturated and unsaturated soils is strongly influenced by adsorption processes, particularly where cationic metals are sorbed onto soil particle imperfections with negative electrical charges. The cation exchange capacity (CEC) represents the total number of negatively charged sites in a given amount of solid at which adsorption and desorption can occur. Clays, such as those present at the former warehouse area waste pile laboratory site, commonly have high CECs. It is expected that adsorption will severely retard the movement of metal contaminants. In addition, in the pH ranges common to ground water flow systems, transport of metals in ground water is limited by their low solubilities.

SECTION 6
RISK SCREENING

Current activities and activity patterns at the site are considered commercial/industrial, as are the documented uses of land surrounding the site. Therefore, for purposes of this risk screening, land use of the site is assumed to be industrial. Previous operations at the site have indicated inorganic metals compounds, PCBs, OC pesticides, and petroleum hydrocarbons to be the principal chemicals of concern (COCs) posing a potential exposure risk to workers involved in commercial/industrial activities on-site.

Inorganic Contaminants

Based on maximum reported surface soil concentrations, no elements had detectable levels greater than the corresponding HBGLs developed by the Arizona Department of Health Services (ADHS) using nonresidential exposure assumptions. Potassium was eliminated from the risk screening based on its relative low toxicity and because its maximum reported concentration was less than the USEPA ceiling limit of $1x10^{+5}$ mg/Kg reserved for less toxic inorganic contaminants. Consequently, from a quantitative risk screening perspective using ADHS health-based standards, reported soil concentrations are considered to reside within an acceptable range under expected occupational exposure conditions.

With the exception of lead, maximum concentrations of all elements in surface soils also were found to be below naturally occurring background levels recorded for the geographical area encompassing the Camp Navajo base (Tetra Tech 1997). According to both USEPA and USACE guidelines, if inorganic chemicals are detected at the site at naturally occurring concentrations, they may be eliminated from the corresponding risk evaluation. Although lead was observed in three soil samples above published background levels, its maximum reported concentration was significantly less than the respective ADHS nonresidential HBGL and was not considered present at risk-adverse concentrations.

Laboratory results for organic COCs also show that maximum reported soil concentrations are below nonresidential ADHS HBGLs in all situations where HBGLs have been developed. Hence, PCBs, OC pesticides, and petroleum hydrocarbons were excluded as COCs because they are not indicated to be present at concentrations high enough to pose a potential exposure or health threat during on-site commercial/industrial activities using ADHS guidelines.

Petroleum hydrocarbon data reported for surface soil samples revealed generalized, low-level concentrations consistent with historical waste disposal practices at the site. However, no samples tested had a TPRH concentration reported above the respective ADHS HBGL. For the TEPH analyses, a method without HBGLs established by ADHS, the maximum reported soil concentration was 780 mg/Kg, a value substantially below the TEPH nonresidential HBGL of 7,000 mg/Kg. In addition, all TEPH results greater than the respective sample quantitation limit were reported by the laboratory as unknown hydrocarbons, and no soil samples had detectable diesel fuel concentrations. Since USEPA and USACE guidelines require the use of chemical-specific data in deriving estimates of potential health risks, TRPH and TEPH data from the site present qualitative evidence of low-level hydrocarbon contamination at concentrations not expected to be health-adverse.

6.1. RISK ASSESSMENT SUMMARY

A group-wide risk assessment for Group B-3 including a quantitative evaluation of the Warehouse Area Waste Pile, was prepared in June 1999(Tetra Tech 1999c). The results of the risk assessment concurred with the risk screening above. No excess carcinogenic risks ($>10^{-6}$) were identified in relation to surface soils or near surface soils. No evaluated noncarcinogenic hazard indices (>1) were identified in relation to surface soils or near surface soils. There is no primary contributor to carcinogenic risks and noncarcinogenic hazard indices in surface and near-surface soils. The ecological risk action level for a selected wildlife indicator species was not exceeded.

SECTION 7
SUMMARY AND CONCLUSIONS

7.1. SUMMARY

Elevated concentrations of lead were identified above background concentrations in three of ten soil samples collected at the site. None of the concentrations exceeded HBGLs

Detectable concentrations of TRPH and Diesel fuel #2 were identified in all 10 soil samples at concentrations well below HBGLs.

One concentration of Aroclor 1260 was detected above its residential HBGL. The soils associated with this concentration were excavated and disposed of in October 1996.

7.2. CONCLUSIONS

Risk evaluation results indicate that the maximum reported concentrations of identified contaminants in surface soils at the site are not expected to result in adverse health effects relevant to commercial/industrial land use. These determinations incorporate the most current ADHS, USEPA, and USACE acceptable target risk criteria into its approach and are intended to be a health-conservative evaluation of potential risk and hazard.

All data collected during this investigation meet quality assurance/QC standards and are considered to be representative of site conditions. Therefore, because detected contamination remaining at the site does not exceed either HBGLs or risk screening level concentrtions, Tetra Tech recommends that ADEQ consider the site for closure.

SECTION 8
REFERENCES

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APPENDIX A

PHOTO DOCUMENTATION

5-7 Panorama Warehouse Waste Pile (Shot 1 of 2), NW, 7/23/94, by Brad Hall

37-7 Clay shoveling soil for surface soil samples, southeast, 9/26/95, by Kali Bronson

37-8 Clay taking surface soil samples, southeast, 9/26/95, by Kali Bronson

37-9 Kevin taking equipment rinsate sample, southeast, 9/26/95, by Kali Bronson

37-10 Kevin taking equipment rinsate sample, southeast, 9/26/95, by Kali Bronson

37-11 Kevin taking equipment rinsate sample, southeast, 9/26/95, by Kali Bronson

37-12 Marcia using slide hammer to take grain size analysis sample, SE, 9/26/95, by Kali Bronson.


SEP 95


SEP 95


SEP 95

APPENDIX B

FIELD NOTES

APPENDIX C

STANDARD OPERATING PROCEDURES

SECTION 1
SURFACE-SOIL SAMPLING

1.1 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the considerations and procedures for collecting representative surface samples. Analysis of surface samples can determine whether concentrations of specific surface pollutants exceed established action levels, and if the concentrations of soil pollutants present a risk to public health, welfare, or the environment.

Materials exposed on the land surface, including soils, sediments, and wastes, are subject to disturbance by weather conditions, vehicle traffic, bioturbation, and other effects. Because volatile contaminants are unlikely to be present in surficial materials, it generally is not necessary to obtain undisturbed samples from the surface. An exception to is when surface samples are collected from beneath an impermeable surface, such as a road or building slab. Surface soils are typically very heterogeneous in compositions and texture, and chemical concentrations in surface soils may vary dramatically over short depth intervals. Often, the first few inches of soil contain gravel, vegetation, or debris. It is desirable to use a sampling method that reduces the impacts of these heterogeneities without biasing the results.

For surface-soil sampling, some judgment may be needed to identify the ground surface datum. The objective is to sample the soil matrix and avoid collecting rock and plant material to the extent possible. Vegetation will be moved aside, dense vegetative matting, detritus or roots will be removed, and gravel will be scraped away to expose the ground surface. Surface samples from beneath pavement or concrete slabs will be collected after first removing road base and gravel to expose the underlying soil. In some locations, such as in the basements of buildings, the ground surface will be below grade. In these cases, depth below grade will be measured and recorded.

1.2 TECHNIQUE - DESCRIPTION

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the type of sample required (disturbed versus undisturbed) and the type of soil. Samples that do not need to be undisturbed may be easily sampled using a spade, trowel, or scoop. Collecting undisturbed samples may be performed using a hand-auger, a trier, or a split-spoon sampler.

1.3 PROCEDURES

1.3.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.

2. Obtain necessary sampling and air monitoring equipment.

3. Decontaminate or preclean equipment, and ensure that it is in working order.

4. Prepare schedules, and coordinate with staff, client, and regulatory agencies as appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

6. Use stakes, buoys, or flagging to identify and mark all sampling locations. Consider specific site factors, including extent and nature of contaminant, when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be cleared for underground utilities by the property owner prior to soil sampling.

1.3.2 Interferences and Potential Problems

There are two primary interferences or potential problems associated with soil sampling. These are cross-contamination of samples and improper sample collection methods. Cross-contamination can be eliminated or minimized through the use of sampling equipment dedicated to each sample location. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection methods include using contaminated sampling equipment, disturbing of the matrix causing in compaction of the sample, or inadequate homogenizing of the samples where required, which results in variable, non-representative analytical results.

1.3.3 Sampling Considerations

This method can be used in most soil types. Surface soil samples may be collected with spades, shovels, or scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop can be used to collect the sample.

Accurate, representative samples can be collected with this procedure depending on the care and precision taken. A flat, pointed mason trowel can be used to cut a block of the desired soil when undisturbed profiles are required. A stainless steel scoop, lab spoon, or plastic spoon will suffice in most other cases. Avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels.

Follow these procedures to collect surface-soil samples.

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.

2. Using a pre-cleaned, stainless-steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.

3. If the sample is to be analyzed for volatile organics, volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless-steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogeneous sample representative of the entire sampling interval. Then, place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly.

1.3.4 Sample Containers and Preservation Techniques

In order to ensure proper sample preservation, samples should be refrigerated to 9°C or less and holding time should be kept to a minimum.

1.3.5 Field Quality Control Sampling Procedures

There are no specific quality-assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.

- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior and after sampling/operation and they must be documented.

1.3.6 Decontamination Procedures

All sample equipment that comes into contact with soil or water must be decontaminated prior to sampling. Decontamination procedures for sampling equipment are described in the Decontamination of Field Equipment SOP.

APPENDIX D

SURVEYOR RESULTS

SiteID	PTID	Northing	Easting	Elevation
WAWP	SS01	28006.59	18244.62	
WAWP	SS02	27996.25	18269.95	
WAWP	SS03	27985.28	18300.38	
WAWP	SS04	27979.43	18325.06	
WAWP	SS05	27943.28	18322.52	
WAWP	SS06	27952.07	18300.17	
WAWP	SS07	27966.16	18265.6	
WAWP	SS08	27979.26	18234.22	
WAWP	SS09	28054.31	18261.87	

APPENDIX E

ANALYTICAL RESULTS TABLE

Description of Qualifiers

J	Data are considered quantitatively estimated.
J+	Data are considered quantitatively estimated with a possible high bias.
J-	Data are considered quantitatively estimated with a possible low bias.
N	Data are considered quantitatively presumptive due to tentative analyte identification.
NJ	Data are considered quantitatively presumptive due to tentative analyte identification; the associated value is considered quantitatively estimated.
R	Data are rejected and considered unusable for all purposes.
U	Analyte is considered not present above the level of the associated value.
UJ	Analyte is considered not present above the level of the associated value; the associated value is considered quantitatively estimated.
UJ-	Analyte is considered not present above the level of the associated value; the associated value is considered quantitatively estimated with a possible low bias.

Warehouse Area Waste Pile
Remediation Parameters

Sample ID	Sample Date	Depth	pH	Percent Water	Total Organic Carbon	Redox Potential
	CRQL		0	0	0.025	0
	Units		PH UNITS	PERCENT	PERCENT	mV
WAWP-SS01S-01	09/27/1995	1	8.4	5.3	NA	NA
WAWP-SS02S-01	09/26/1995	1	8.2	3.7	NA	NA
WAWP-SS03S-01	09/26/1995	1	8.3	13	NA	NA
WAWP-SS04S-01	09/27/1995	1	8.2	10	NA	NA
WAWP-SS05S-01	09/26/1995	1	8.6	4	0.57	263
WAWP-SS06S-01	09/26/1995	1	8	9.6	NA	NA
WAWP-SS07S-01	09/27/1995	1	7.5	5.1	NA	NA
WAWP-SS08S-01	09/27/1995	1	7.8	7.5	NA	NA
WAWP-SS09S-01	09/27/1995	1	7.5	3.3	NA	NA
WAWP-SS10S-01	09/26/1995	1	8.9	16	NA	NA

Warehouse Area Waste Pile
Metals

Sample ID	Sample Date	Depth	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Lead, Total	Mercury, Total	Potassium, Total	Selenium, Total	Silver, Total
	CRQL		0.5	2	0.2	0.2	0.5	0.5	0.2	500	0.5	0.5
	Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	0.91	153	0.49	<0.05	15.6	8	<0.033	1040	<0.3	0.16 J
WAWP-SS02S-01	09/26/1995	1	2.2	99.8	0.7	0.2 U	11.4	24.4	<0.033	1190	<0.6	<0.2
WAWP-SS03S-01	09/26/1995	1	2.9	88.4	0.5	<0.05	9.6	32.2	<0.033	1140	0.41 J	<0.1
WAWP-SS04S-01	09/27/1995	1	1.1	36.1	0.38	<0.05	5.7	19.4	<0.033	606	<0.3	<0.1
WAWP-SS05S-01	09/26/1995	1	0.56 J	94.8	0.41	1 J	14.4	90.5 J	<0.033	1060	<0.3	<0.1
WAWP-SS06S-01	09/26/1995	1	0.7 J	365	1	0.31 J	19	8.2	<0.033	1350	<0.6	0.25 J
WAWP-SS07S-01	09/27/1995	1	0.88	144	0.73	<0.05	12.1	9.7	<0.033	885	<0.3	0.12 J
WAWP-SS08S-01	09/27/1995	1	<0.3	78.5	0.36	<0.05	16	7.6	<0.033	771	0.33 J	<0.1
WAWP-SS09S-01	09/27/1995	1	1.6	216	0.77	<0.05	18.6	13.1	<0.033	1570	<0.3	0.15 J
WAWP-SS10S-01	09/26/1995	1	1.1 J	116	0.52	0.3 UJ	14.9	40.1 J	<0.033	1210	<0.3	0.13 J

	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Potassium	Selenium	Silver
Analyses	10	10	10	10	10	10	10	10	10	10
Detections	9	10	10	4	10	10	0	10	2	5
Maximum Concentration	2.9	365	1	1	19	90.5	0	1570	0.41	0.25
Arizona HBGL - Nonresidential	3.82	28700	1.34	244	5950	1400	123		2030	2030
Arizona HBGL - Nonresidential Hits	0	0	0	0	0	0	0		0	0
Maximum Background Concentration	44	1610	5	1.5	90	30	0.3	0	0.8	2.6
Background Hits	0	0	0	0	0	3	0	0	0	0

Warehouse Area Waste Pile
Petroleum Hydrocarbons

Sample ID	Sample Date	Depth	TPH, Recoverable	Diesel Fuel 2
	CRQL		10	10
	Units		mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	30 J-	49 J+
WAWP-SS02S-01	09/26/1995	1	45 J-	290 J+
WAWP-SS03S-01	09/26/1995	1	280 J-	780 J
WAWP-SS04S-01	09/27/1995	1	290 J-	220 J
WAWP-SS05S-01	09/26/1995	1	350 J-	12 J
WAWP-SS06S-01	09/26/1995	1	68 J-	<0
WAWP-SS07S-01	09/27/1995	1	300 J-	360 J+
WAWP-SS08S-01	09/27/1995	1	30 J-	<0
WAWP-SS09S-01	09/27/1995	1	120 J-	560 J
WAWP-SS10S-01	09/26/1995	1	200 J-	<0

Analyses	10	10
Detections	10	7
Maximum Concentration	350	780
Arizona HBGL - Nonresidential		
Arizona HBGL - Nonresidential Hits		
Arizona HBGL - Residential	7000	
Arizona HBGL - Residential Hits	0	

Warehouse Area Waste Pile
Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)

Sample ID	Sample Date	Depth	4,4-DDD	4,4-DDE	4,4-DDT	Aldrin	alpha-BHC	alpha-Chlordane	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248
	CRQL		0.0033	0.0033	0.0033	0.0017	0.0017	0.0017	0.033	0.067	0.033	0.033	0.033
	Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	0.015 J	<0.0012 UJ	0.019	<0.0005	<0.0015	<0.00055	<0.0095	<0	<0	<0	<0
WAWP-SS02S-01	09/26/1995	1	<0.014	<0.0048 UJ	<0.0124	<0.002	<0.006	<0.0022	<0.038	<0	<0	<0	<0
WAWP-SS03S-01	09/26/1995	1	<0.035	<0.012 UJ	<0.031	<0.005	<0.015	<0.0055	<0.095	<0	<0	<0	<0
WAWP-SS04S-01	09/27/1995	1	<0.035	<0.012 UJ	<0.031	<0.005	<0.015	<0.0055	<0.095	<0	<0	<0	<0
WAWP-SS05S-01	09/26/1995	1	<0.0035	<0.0012 UJ	<0.0031	<0.0005	<0.0015	<0.00055	<0.0095	<0	<0	<0	<0
WAWP-SS06S-01	09/26/1995	1	<0.0035	<0.0012 UJ	<0.0031	<0.0005	<0.0015	<0.00055	<0.0095	<0	<0	<0	<0
WAWP-SS07S-01	09/27/1995	1	<0.035	<0.012 UJ	<0.031	<0.005	<0.015	<0.0055	<0.095	<0	<0	<0	<0
WAWP-SS08S-01	09/27/1995	1	<0.007	<0.0024 UJ	<0.0062	<0.001	<0.003	<0.0011	<0.019	<0	<0	<0	<0
WAWP-SS09S-01	09/27/1995	1	<0.035	<0.012 UJ	<0.031	<0.005	<0.015	<0.0055	<0.095	<0	<0	<0	<0
WAWP-SS10S-01	09/26/1995	1	<0.0035	<0.0012 UJ	<0.0031	<0.0005	<0.0015	<0.00055	<0.0095	<0	<0	<0	<0

	4,4-DDD	4,4-DDE	4,4-DDT	Aldrin	alpha-BHC	alpha-Chlordane	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248
Analyses	10	10	10	10	10	10	10	10	10	10	10
Detections	1	0	1	0	0	0	0	0	0	0	0
Maximum Concentration	0.015	0	0.019	0	0	0	0	0	0	0	0
Arizona HBGL - Nonresidential	23.9	17	17	0.34	0.92	4	0.76	0.76	0.76	0.76	0.76
Arizona HBGL - Nonresidential Hits	0	0	0	0	0	0	0	0	0	0	0

Warehouse Area Waste Pile
Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)

Sample ID	Sample Date	Depth	Aroclor 1254	Aroclor 1260	beta-BHC	delta-BHC	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulfate	Endrin	Endrin aldehyde	Endrin ketone
	CRQL		0.033	0.033	0.0017	0.0017	0.033	0.0017	0.033	0.033	0.033	0.033	0.033
	Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	<0	<0.012	<0.006	<0.00049	<0.0028	<0.0055	<0.00125	<0.0011 UJ	<0.00315	<0.0012 UJ	<0.0013 UJ
WAWP-SS02S-01	09/26/1995	1	<0	<0.048	<0.024	<0.00196	<0.0112	<0.022	<0.005	<0.0044 UJ	<0.0126	<0.0048 UJ	<0.0052 UJ
WAWP-SS03S-01	09/26/1995	1	<0	<0.12	<0.06	<0.0049	<0.028	<0.055	<0.0125	<0.011 UJ	<0.0315	<0.012 UJ	<0.013 UJ
WAWP-SS04S-01	09/27/1995	1	<0	<0.12	<0.06	<0.0049	<0.028	<0.055	<0.0125	<0.011 UJ	<0.0315	<0.012 UJ	<0.013 UJ
WAWP-SS05S-01	09/26/1995	1	<0	0.33	<0.006	<0.00049	<0.0028	<0.0055	<0.00125	<0.0011 UJ	<0.00315	<0.00125 UJ	<0.0013 UJ
WAWP-SS06S-01	09/26/1995	1	<0	<0.012	<0.006	<0.00049	<0.0028	<0.0055	<0.00125	<0.0011 UJ	<0.00315	<0.0012 UJ	<0.0013 UJ
WAWP-SS07S-01	09/27/1995	1	<0	<0.12	<0.06	<0.0049	<0.028	<0.055	<0.0125	<0.011 UJ	<0.0315	<0.012 UJ	<0.013 UJ
WAWP-SS08S-01	09/27/1995	1	<0	<0.024	<0.012	<0.00098	<0.0056	<0.011	<0.0025	<0.0022 UJ	<0.0063	<0.0024 UJ	<0.0026 UJ
WAWP-SS09S-01	09/27/1995	1	<0	<0.12	<0.06	<0.0049	<0.028	<0.055	<0.0125	<0.011 UJ	<0.0315	<0.012 UJ	<0.013 UJ
WAWP-SS10S-01	09/26/1995	1	<0	0.29	<0.006	<0.00049	<0.0028	<0.0055	<0.00125	<0.0011 UJ	<0.00315	<0.0012 UJ	<0.0013 UJ

	Aroclor 1254	Aroclor 1260	beta-BHC	delta-BHC	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulfate	Endrin	Endrin aldehyde	Endrin ketone
Analyses	10	10	10	10	10	10	10	10	10	10	10
Detections	0	2	0	0	0	0	0	0	0	0	0
Maximum Concentration	0	0.33	0	0	0	0	0	0	0	0	0
Arizona HBGL - Nonresidential	0.76	0.76	3.19	3.19	0.38	2450	2450		123		
Arizona HBGL - Nonresidential Hits	0	0	0	0	0	0	0		0		

Warehouse Area Waste Pile

Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)

Sample ID	Sample Date	Depth	gamma-BHC (Lindane)	gamma-Chlordane	Heptachlor	Heptachlor epoxide	Methoxychlor	Toxaphene
	CRQL		0.0017	0.0017	0.0017	0.0017	0.017	0.17
	Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
WAWP-SS01S-01	09/27/1995	1	<0.00175 J	<0.00055	<0.0017	<0.0006	<0.019	<0.115
WAWP-SS02S-01	09/26/1995	1	<0.007	<0.0022	<0.0068	<0.0024	<0.076	<0.46
WAWP-SS03S-01	09/26/1995	1	<0.0175	<0.0055	<0.017	<0.006	<0.19	<1.15
WAWP-SS04S-01	09/27/1995	1	<0.0175	<0.0055	<0.017	<0.006	<0.19	<1.15
WAWP-SS05S-01	09/26/1995	1	<0.00175	<0.00055	<0.0017	<0.0006	<0.019	<0.115
WAWP-SS06S-01	09/26/1995	1	<0.00175	<0.00055	<0.0017	<0.0006	<0.019	<0.115
WAWP-SS07S-01	09/27/1995	1	<0.0175	<0.0055	<0.017	<0.006	<0.19	<1.15
WAWP-SS08S-01	09/27/1995	1	<0.0035	<0.0011	<0.0034	<0.0012	<0.038	<0.23
WAWP-SS09S-01	09/27/1995	1	<0.0175	<0.0055	<0.017	<0.006	<0.19	<1.15
WAWP-SS10S-01	09/26/1995	1	<0.00175	<0.00055	<0.0017	<0.0006	<0.019	<0.115

Analyses	10	10	10	10	10	10
Detections	0	0	0	0	0	0
Maximum Concentration	0	0	0	0	0	0
Arizona HBGL - Nonresidential	4	4	1.3	0.63	2030	5
Arizona HBGL - Nonresidential Hits	0	0	0	0	0	0

APPENDIX F

SOIL PHYSICAL CHARACTERISTICS

APPENDIX G

QUANTERRA CERTIFICATES OF ANALYSIS

Note: Certificates of Analysis will be provided in select copies of the Final Report. For access to a complete copy of the Certificates of Analysis, please contact the Camp Navajo Environmental Office at (520) 773-3208.

APPENDIX H

MORRISON KNUDSEN, CORP.
CLOSURE REPORT FOR REALLOCATED WORK

Note: Only sections that pertains to the Warehouse Area Waste Pile are included in this Appendix.

APPENDIX I

SCOPE OF WORK